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Education Saves Lives — The Fire Performance of Wood Trusses Part 2 by Molly E. Butz

John F. Kennedy said, "The goal of education is the advancement of knowledge and the dissemination of truth." In an effort to provide a well-rounded and factual foundation regarding metal plate connected wood trusses, Section 2 of the Carbeck Structural Components Institute (CSCI) Fire Education Program, The Fire Performance of Wood Trusses, takes a brief look at the historical progression of the truss industry. Part 1 of this series (see the June/July 2003 issue of SBC Magazine) established the CSCI and Houston Fire Department (HFD) collaboration on this program as a means to produce "something positive" following a tragic fire. That objective can be achieved through the words of President Kennedy. Knowledge is the key to education, and a well-educated fire service is the key to safety on the fire ground.

Wood trusses have been around for centuries, from their beginnings in heavy timber construction throughout their development to present day metal plate connected wood trusses. Heavy timber trusses began with bolt and plate or split ring connectors, and, although they are no longer commonly used in construction, special situations find an occasional use for them. The next transition in trusses was a move to plywood gussets shortly after World War II, which were both easier and more economical to manufacture. In 1952, the light gauge steel connector plate was invented by A. Carroll Sanford, followed by an improved version of the connector plate by Cal Juriet in 1956. Juriet's adaptation incorporated integrated teeth punched into the steel plate using a punch press.

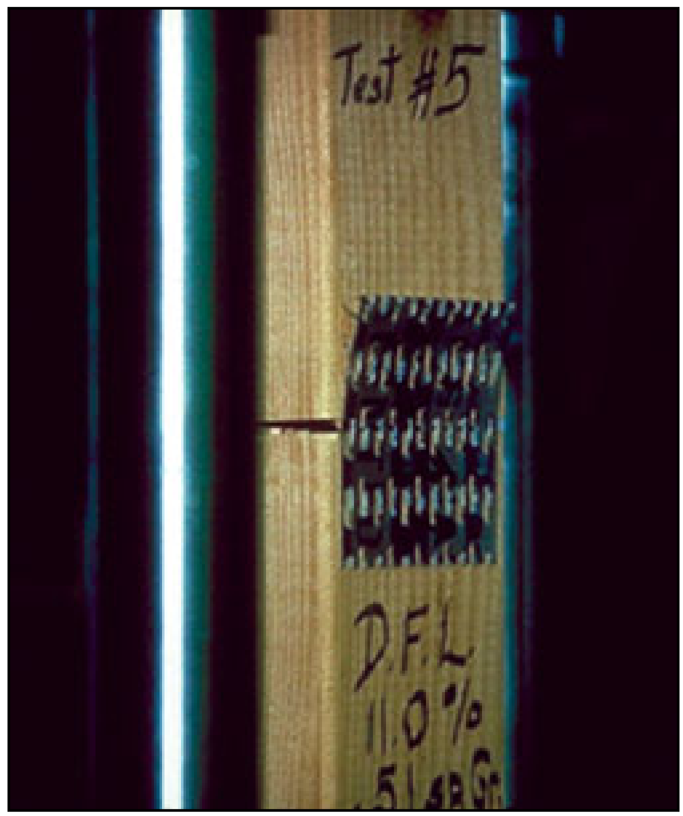

FIGURE 1

Today, the wood truss industry grosses more than $10 billion each year[1] and, according to a study performed by the National Association of Home Builders (NAHB), structural components represent roughly 60 percent of the residential market share and more than 70 percent of the multi-family market share. Trusses can be used for all types of construction, from affordable housing to million dollar estates and commercial projects. Not only are wood trusses efficient and cost effective, they also allow for the use of smaller material, which is of particular importance when considering ever growing concerns about our valuable lumber resource. However, as more glued composites and fiber reinforced products become available, they will be integrated into truss manufacturing and other highly engineered products.

The second section of the CSCI Fire Education Program also describes a diverse array of testing that is performed on metal plate connectors, as well as full scale truss testing. The results of these evaluations are crucial, as they begin to dispel one of the most commonly misunderstood observations on the fire scene, plate cupping. It is often thought that the phenomenon surveyed on the fire ground known as plate cupping is caused by excessive heat or fire (see Figure 1). However, cupping, or withdrawal resistance failure, is actually the result of excessive load, and is viewed at the scene of a fire when a truss is forced to take on extra load because of a weakened chord member due to wood charring.

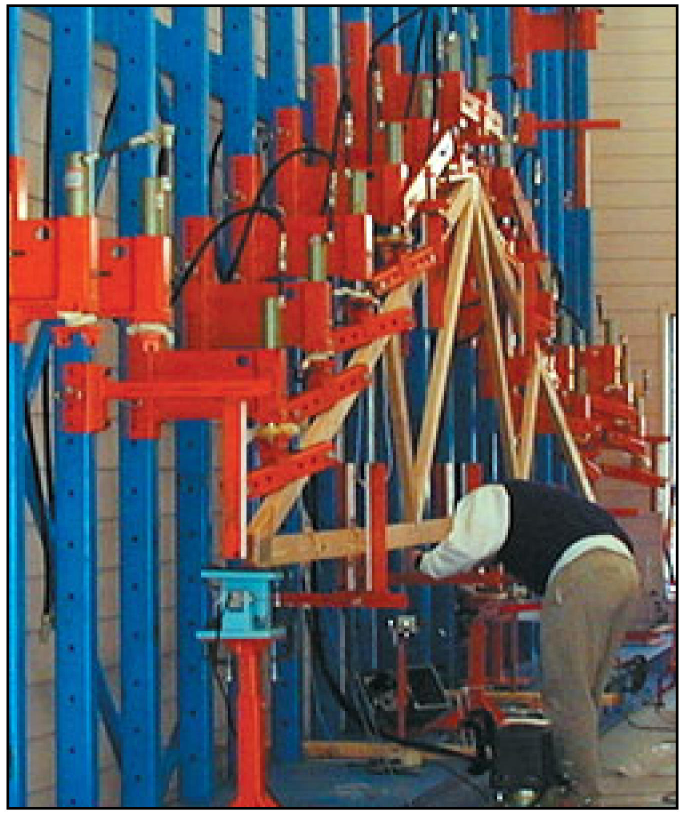

FIGURE 2

Truss plates also endure tension strength, tension shear and compression shear testing. All of this small scale testing is compiled and used to create design models so that a wide variety of trusses can withstand a wide range of load capacities. The small scale tests on metal connector plates are confirmed through full scale truss testing. Although historically, full scale truss testing was not elaborate, today sophisticated test jigs and racks are used (see Figure 2).

Section 2 of the CSCI Fire Education Program concludes with a short video demonstration. A truss roof system was set up by the Fish Building Company in Madison, Wisconsin. The bottom chord of one truss in the system was intentionally given a defect, then 240 pounds of weight was applied in two different places to simulate the weight of construction workers. One of the truss members was cut clear through; neither the truss nor the system failed, establishing that cutting one member of a truss does not cause the entire truss to fail.

All of the industry testing has led to the acceptance of truss industry products by building officials and specifiers worldwide. Each truss plate has its own code accepted by National Evaluation Report (NER), and each truss is individually engineered with highly sophisticated software that allows for each truss to perform as expected given specific load conditions and code requirements.

The information covered in the second section of The Fire Performance of Wood Trusses program provides a brief but pertinent background of truss history. This foundation of knowledge paves the way for the remaining six sections of the CSCI Fire Education Program which discuss truss manufacturing and application, truss exposure to fire and detailed fire testing performed by the American Society for Testing and Materials (ASTM) and Phoenix Fire Department. Establishing these truths about modern-day truss construction can mean enhanced protection on the fire ground where life saving decisions can be made.

[1]"Conditions of Competition on the U.S. Market for Wood Structural Building Components" by United States International Trade Commission, Investigation No. 332-445, USITC Publication 3596, April 2003.

Look for the third installation in this series in the September/October 2003 issue of SBC Magazine which will focus on Section 3 of the CSCI Fire Education Program, The Truss Manufacturing Process.

SBC HOME PAGE

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